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Article

Open Access—Are the Barriers to Change Receding?

Bo-Christer Björk

HANKEN School of Economics, Department of Management and Organization,
P.O. Box 479, Helsinki 00101, Finland; E-Mail: Bo-Christer.Bjork@hanken.fi;
Tel.: +358-503-553-425

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Abstract: The move from subscription only publishing of scholarly articles to open access has been much slower than previously anticipated by many Open Access (OA) advocates. Despite the many advantages that OA offers, this particular branch of E-commerce imposes several formidable barriers to change. A framework conceptualizing these barriers that was developed over a decade ago was revisited to see if the significance of these barriers has changed. Nowadays, building the IT infrastructure, support from indexing services and finding a sustainable business model are no longer important barriers. For gold OA publishing the academic reward system is still a major obstacle, whereas more marketing and critical mass is needed for both gold OA and green OA. Green OA self-archiving is still also strongly affected by what subscription publishers allow. In the overall balance the situation has nevertheless improved significantly.

Keywords: open access; scholarly journal; business model; gold OA; green OA

1. Introduction

Ten years ago, I made a study of the Open Access situation and an analysis of the major barriers holding back the development; *Open Access to scientific publications—an analysis of the barriers to change?* [1]. During the past decade a lot has happened and we are a bit closer to realizing the dream of freeing the scientific literature. However, developments have by no means been as fast as many of us predicted and as we would have wished, and there are still significant obstacles to overcome. This call for a special issue and its specific scope of discussing “the most significant developments and enhancements, beyond the Berlin Declaration, in the last 10 years” inspired me to revisit my earlier article to see what has changed and what has remained the same.

The term Open Access (OA) is usually applied to the context of scholarly publications and data, and means their free availability on the web for reading, data mining and reuse, in contrast to other types of freely available web content [2]. Open Access has been practiced since the World Wide Web was launched but the term itself was taken into wide use around 2002. OA can for peer reviewed journal articles be achieved in two major ways [3], by publishing in journals that in themselves make the content freely available (Gold OA) or by the author or a third party making a copy of the article or the preceding manuscript available somewhere else on the web, for instance in a subject or institutional repository (Green OA). There are currently several variations of OA, what John Willinsky calls flavors [4], depending on factors such as timing, license, business model, *etc.*

From a business perspective OA can be seen as disruptive innovation [5,6]. Already from the start, leading publishers perceived OA as a threat to their currently very comfortable profit levels and have spent quite a lot of efforts on anti-OA lobbying, in particular when institutions such as the UA legislative or the European Commission have been considering policies that, via the funding agencies, would speed up the development towards more OA. OA as a movement has not started inside the publishing establishment, but has been driven by researchers, university libraries and new start-up publishers.

In many other industries developments triggered by the Internet have been more rapid than in scholarly publishing. Despite the obvious advantages of OA to almost all stakeholders there are certain unique characteristics of the scholarly communication and career building systems that have made it remarkably resistant to change.

Table 1 below was in the earlier study used as a starting point for a discussion about the prerequisites and barriers for open access publishing. The three channels discussed were open access journals, subject and institutional repositories. Self-posting on the web was left outside the discussion, even though it is a rather important channel even at present.

Table 1. A classification of different types of barriers for increased open access publishing and their relative importance, situation 2003.

	Open access Journals	Subject repositories	Institutional repositories
Legal framework	-	*	**
IT-infrastructure	**	*	**
Business models	***	**	*
Indexing services and standards	**	-	***
Academic reward system	***	*	*
Marketing and critical mass	***	**	***

The barriers and means were classified into six different categories: *Legal framework*, *IT-infrastructure*, *Business models*, *Indexing services and standards*, *Academic reward system*, *Marketing and critical mass*. In the table, the number of asterisks (from zero to three) denoted the importance of a particular barrier in hindering a rapid transition process. The importance was a subjective judgment made by the author. Thus, in the opinion of this author there were no (or very small) legal obstacles for the proliferation of Open Access Journals, whereas this was at the time seen as a central issue to be solved if institutional repositories are to take a prominent position in the OA provision. Major obstacles for

the proliferation of OA journals were deemed to be sustainable business models, recognition in the academic reward systems and critical mass.

In the following these barriers, and what has changed in decade, will be discussed one by one.

2. Legal Framework

2.1. Open Access Journals

Already in 2003, copyright issues constituted no barrier for the proliferation for OA journals. Obviously, for journals offering OA only for the electronic version, authors were usually bound by the agreements they had made with the publisher and readers could at least access the text on equal terms with the paper version. Most born OA journals even lacked explicit agreements with the authors or information about usage rights for readers. Since then the situation has become clearer due to the rising popularity of Creative Commons licenses for OA journals, which among other things, make data mining of the content easier. Of 14 large OA publishers studied in the EC funded SOAP project, seven, representing 72% of 616 journals, were using Creative Commons licenses [7]. Among smaller publishers the CC licenses were only used by 27% of journals.

2.2. Subject Repositories

Some subject repositories, like arXiv for physics and mathematics, were already well established 10 year ago, but the rise of PubMedCentral was yet to come. Before 2003 the copyright agreements of many publishers did not even mention posting of self-archived copies. Since then almost all explicitly take a stand on what is permissible and what is not. The general trend seems to be to allow posting only on home pages and in institutional repositories, perhaps since these are perceived as less of a threat compared to subject repositories. In an on-going study of the copyright policies of the 100 largest publishers with journals indexed in Scopus, representing a total volume of 1.15 million yearly articles, immediate self-archival of the accepted version was allowed for 62% of the articles on home pages, 61% in institutional repositories but only 21% in subject repositories [8]. If journals allowing uploading only after an embargo period of up to 24 months are added, the total share for which green self-archiving is allowed raises to 81%.

PubMedCentral and the related NIH mandate to upload publications from its funded projects is such a strong influence that special regulations have been put in place for it by many publishers. According to the study above, 67 of the top 100 publishers have explicit NIH self-archiving compliancy regulations [8].

2.3. Institutional Repositories

The earlier article already contained a discussion about how publishers' attitudes towards allowing posting in institutional repositories would be dependent on how strong a threat they perceived them to be to their subscription bases. At that time the first IRs had started to develop and the growth has later been accelerated by the use of open source software like D-space and E-prints. A majority of publishers nowadays allow posting of the author's accepted manuscript in an IR, sometime with an embargo period. An interesting case is Elsevier, which for many years allowed this unconditionally.

However, recently, they have changed policy and nowadays only allow if it is voluntary for the author. If an institution has a mandate requiring article manuscripts to be archived in their repository, Elsevier requires a separate agreement with the institution in question.

3. IT-Infrastructure

3.1. Open Access Journals

Ten years ago, the quality of the IT infrastructure of OA journals varied a lot and many journals had simple systems developed specifically for them, often by voluntary coders, in some cases even the editors themselves. Submissions and the review process were still mostly handled by email and web pages varied between static HTML and sophisticated data base driven solutions for a couple of leading publishers. Nowadays, most journals use web submission and workflow systems, either using proprietary systems or the Open Journal Systems. For the publication of the accepted papers a lot of established journals are using collaborative or third party platforms such as Scielo, J-Stage and Highwire press. Mainstream publishers can use the same platforms they use for the electronic versions of their subscription journals. Leading OA publishers BioMedCentral and PloS have developed features in their platforms which go beyond what most established publishers offer (download statistics, access to the review process data *etc.*).

3.2. Subject Repositories

A number of leading subject repositories were already quite developed in 2003 and had developed their own customized solutions. Today the situation is such that only a small share of repositories have their own IT-infrastructure, almost all mid-sized and small ones are run on top of openly available repository software such as Eprints, D-Space and Opus.

3.3. Institutional Repositories

There were hardly any institutional repositories in existence in 2003, and University of Southampton and MIT, where D-Space and Eprints were developed, were among the first. Since then, the number of IRs has grown very rapidly, almost all using Open Source solutions. In contrast to subject based repositories, where it might not be so easy to find a suitable organization for hosting the web server, IRs fall naturally into a university's organization, often under its library.

4. Business Models

4.1. Open Access Journals

In 2003, the vast majority of OA journals were either new born electronic only journals founded by independent academics, or established society journals which had decided to make their electronic version free of charge when they started publishing a parallel e-version. In both cases the journals did not charge authors for publishing, in the case of e-only journals the operations were based on voluntary work in the spirit of Open Source projects and in the case of established journals they could rely on subscriptions to the printed version and/or society membership fees to fund operations. The problem is

that both these “business models” more or less reached their limits shortly afterwards. The voluntary work model functions for small journals with a limited number of manuscripts but does not really scale to bigger journals, where some form of steady income is needed. The subscription print and free e-version model is not attractive to commercial publishers and with quite a high share of society or university press journals already offering either immediate or delayed open access to the e-version, a saturation point seems to have been reached.

The growth in OA publishing is increasingly coming from newly founded OA journals that charge authors or their organizations for the publishing services [9]. The APC model has by now proved that it can work as a business model, a good indication of this is for instance Springer’s purchase of BioMedCentral in 2008. Until 2008 such journals were almost exclusively founded by newly founded publishers which specialized in OA publishing (*i.e.*, BioMedCentral, Public Library of Science and Hindawi). However, in recent years major established publishers have started to enter the market by founding OA journals of their own. A recent trend has been the founding of so-called “megajournals” in the wake of the phenomenal success of PLoS ONE, which in its seventh year is publishing over 20,000 articles. Journals in this category (for instance Nature Scientific Reports, Springer Plus, Sage Open) have extremely broad topics and a rapid review process only evaluating scientific rigor, not perceived contribution.

Conversions of subscription journals to APC-funded OA have been quite rare, one example being Nucleic Acids Research. A highly interesting initiative is the SCOAP3 consortium (Sponsoring Consortium for Open Access Publishing in Particle Physics), which aims to convert a dozen of the leading journals in high energy in full or partially to APC funded OA. In this case the APCs will not be paid by authors or even their institutions, but by the consortium, which includes the leading research laboratories in the field (*i.e.*, CERN). This model, even if successful, is however not likely to be replicable to other fields of science.

Major publishers have also started to offer authors the possibility to open up their individual articles in subscription journals against a payment, but this “hybrid OA” has not become popular due the generally high price level and the perception that greedy publishers are trying to charge twice for the same service [10].

One can of course ask the question: why are the big publishers not converting their journals on a broader scale to OA? The reason is simply that despite all the hype about OA they have yet to experience any significant reductions in their subscription income. Between 2005 and 2011 the profitability of several major publishers increased. Elsevier increased its operating profit margin from 31% to 37%, Informa, which includes Taylor&Francis, from 25% to 36% ,Wolters Kluwer Health from 16% to 20% and John Wiley STM for the period 2008–2011 from 39% to 43% [11].

Hence, the current strategy seems to be to wait and see and experiment on a small and economically risk-free scale with OA, in order not to miss the train when and if it starts accelerating. For instance Elsevier’s operating profit margin for journal publishing has been around 30% to 35% for the last decade and half and has so far not shown any indications of going down. Since the bulk of the publisher’s income comes from big deal e-licenses, which are usually multi-year deals, it will take some time before any effects of journal cancellations from libraries, due to an increase in OA material, would start to take effects [12].

4.2. Subject Repositories

The business models for subject repositories, for a majority of cases, resemble the business models for born OA journals, and they are run predominantly using voluntary labor, open source IT platforms, and free hosting by a university or university department [13]. Some of the biggest repositories with several hundred thousand manuscripts have had to develop mechanisms for earning income from providing dissemination services to institutions using them as publishing platforms for their working paper series or for acting as middleman for subscription or pay-per-view content, as is the case for SSRN [14], or from “membership” payments from research institution as in the case of arXiv [15]. The one highly visible exception is PubMedCentral, which is a central element in the research funding and dissemination strategy of the world’s biggest research funding organization NIH.

4.3. Institutional Repositories

In contrast to subject repositories, institutional repositories have usually been created by a decision at top management level in universities, and they are handled much like any infrastructure such as library services. The problem is obviously that often such management decisions have been preceded by a lot of internal lobbying from OA proponents. The decision to invest in an IR also often goes hand in hand with the taking into use of research reporting facilities (so-called CRIS).

A factor facilitating the decisions is that an IR fits very naturally into the agenda of a university library, which has seen other functions like the handling of paper journals diminish.

5. Indexing Services and Standards

5.1. Open Access Journals

In the past 10 to 15 years, web navigation techniques have changed a lot. In the early days it was very important for journals’ web sites to be included in link lists of portals of different types so that readers could find out about the content. Nowadays it is increasingly important to make the content discoverable by search engines, since researchers more and more get to a paper via a search using the article name or author in Google or Google scholar or using a topic related key word search. Tenopir *et al.* [16] have for instance, in a longitudinal study of how scientists seek and read interesting articles, noted a rapid increase from 9% to 23% between 1993 and 2005 in automated searching as a method of finding interesting articles to read, in parallel with a decline in browsing (journals themselves or tables of content).

In 2003, only slightly over 200 OA journals were included in the only available index, Web of Science [17]. In that same year the Directory of Open Access Journals (DOAJ) was launched and has grown from an initial 300 journals to over 8,000. In addition, Elsevier launched a competitor for WoS, Scopus, which today indexes around 18,500 journals, compared to around 11,000 in WoS. Of the DOAJ journals 2,012 are also included in Scopus [18] and 610 in WoS [19]. Current numbers are likely to be slightly higher.

5.2. Subject Repositories

In the 1990s, when some of the leading subject repositories developed, a central idea of the repositories was to provide portals to research literature in the fields. Today, with the power of general search engines and awareness tools this function is less important, but repositories like arXiv and PMC are still to a high extent used directly [20].

5.3. Institutional Repositories

Unlike subject repositories, institutional repositories have never been intended as places where to search directly for manuscripts, rather their function has been to provide long term permanent storage solutions. Nevertheless an effort has been to make their content technically easy to harvest for more aggregated (often subject based) web services, using the OAI protocol for meta-data harvesting.

6. Academic Reward System

6.1. Open Access Journals

In their choice of publication outlets academics are very much driven by the prestige of the journals at hand [21]. Moreover, prestige usually requires time to accumulate, which puts recently founded OA journals at a disadvantage. In the early days there was also a strong bias against web publishing as not being peer reviewed at all and content, which would rapidly disappear. The situation has further been aggravated by the almost monopoly-like situation of Web of Science via its impact factor metrics. WoS yearly accepts only a small percentage of new applicant journals, and there is a strong emphasis on these impact factors in academia for further journal rankings for promotion, research assessment exercises, *etc.* Despite innovative web sites of some OA publishers including alternative article level metrics (downloads, mentions in social media, blogs, *etc.*) features which are definitely attractive to the authors, such article level impact metrics are not yet a factor of importance in academic evaluations.

The situation has nevertheless improved, since many of the better OA journals are nowadays ISI indexed and have in some cases even achieved top ranking positions within their specialties. One way to quickly establish a high prestige for new OA journals is by involving very highly credited researchers with a journal, as is the case with e-Life, which aims to compete in the same league as Nature and Science.

In addition to the prestige structure inside the research community itself, an important aspect is the how research funders reward and punish recipients of their funding. Since 2003, many important steps forward have been taken, including OA publishing mandates (in one form or the other) of Wellcome Trust, NIH and most recently Research Councils UK. Although such mandates are usually neutral concerning gold or green OA, they can strongly back journal publishing if earmarked funds are made easily available to pay APCs in Gold OA journals [22].

6.2. Subject Repositories

In the earlier study it was pointed out that the only reward mechanism at play concerning uploading to subject repositories was author self-interest, the promise of being more widely read and cited due to the OA copy. Many studies have been carried out, most of which have found a significant OA citation effect, usually evident in cases where green copies have been uploaded of a subset of articles in subscription journals (for good overviews of the research literature see [23,24]). One important development in the past decade is that NIH has created its mandate requiring authors with grant funding to upload copies to the PubMedCentral repository. The NIH has reported a compliance rate of 75% [25]. The influence of this mandate has been so strong that many journals prefer to upload NIH funded articles (possibly after an embargo period) or even all articles directly to PMC.

6.3. Institutional Repositories

As with subject repositories the main reward mechanism has been self-interest; however, increasingly, universities have started mandating OA self-archiving, as an alternative to publishing in OA journals. Gargouri *et al.* [26] studied the uptake levels (in terms of all published journal articles) for three universities and one research institute with OA mandates and compared those with the uptake levels of a bigger selection of universities without mandates. They found an average uptake of around 60% for institutions with mandates, compared to around 15% for institutions without.

7. Marketing and Critical Mass

7.1. Open Access Journals

Compared to 10 years ago, the market share and reputation of OA journals has improved substantially, from around 500 DOAJ registered journals to over 8000. Some of the leading OA journals, for instance PLoS Biology or Nucleic Acids Research, are probably no longer even viewed as primarily OA journals but just as leading journals in their fields.

The rapid overall growth in OA publishing is not quite uniform across scientific disciplines, with medicine and biology having had the fastest growth measured in article volume [9].

7.2. Subject Repositories

Most of the major subject repositories were founded already in the 1990s or in the first half of the last decade, and growth has mainly come in these rather than via recently founded new initiatives. There are fewer functions for such repositories to fill nowadays, due to the efficiency of general search engines and for many authors institutional repositories are nowadays available as viable options. As a result, the situation is rather patchy, in the sense that subject repositories are very important in some subjects, but absent in others.

7.3. Institutional Repositories

The number of institutional repositories has grown very rapidly in recent years. One important development is also the increased use in universities of current research information systems (CRIS) to

collect metadata about publications, used for instance in reporting to ministries, research assessment exercises *etc.* Since all researchers have to update these records yearly, the threshold to also upload a green copy to the IR (in ideal cases integrated with the CRIS systems) is lowered.

8. Conclusions

Against the background of the discussion above, let us go back to the major identified barriers and see what has changed. The changes in importance of a barrier have been indicated with an arrow (Table 2).

Table 2. The classification of different types of barriers for increased open access publishing and their relative importance, revisited 2013.

	Open access Journals	Subject repositories	Institutional repositories
Legal framework	-	* ↓ **	** ↓ *
IT-infrastructure	** ↓ -	*	** ↓ -
Business models	*** ↓ *	**	* ↓ -
Indexing services and standards	** ↓ *	-	*** ↓ -
Academic reward system	*** ↓ **	*	*
Marketing and critical mass	*** ↓ **	**	*** ↓ **

The overall conclusion is that several of the barriers are lower today than 10 years ago. The only area where the barrier might be higher concerns the legal ramification for posting copies of published papers in subject repositories, due to the fact that many publishers have defined policies where they have allowed posting in institutional repositories but not in subject repositories. Of particular importance is that the APC-funded business model for running Open Access journals has proved its sustainability, at least in biomedical publishing, and that suitable institutional repositories are starting to be available for most authors.

In the call for this special issue there was a specific question of how the Berlin Open Access declaration, from 2003, has changed the face of scholarly publications. The Berlin declaration is part of a number of manifestos and declarations from stakeholders lobbying for increased OA, many of which were issued about a decade ago. Other important ones include the Budapest Open Access Initiative, which was renewed in 2012, the Bethesda Statement on Open Access Publishing and the online petition from a group of scientists in 2001, which indirectly contributed to the founding of the

major OA publisher Public Library of Science. All of these have without doubt been important milestones in raising the awareness about OA and its benefits, but it is impossible to quantify the effects. If these were placed within the conceptual framework of this article they would fall into the slot “marketing”, although they could not be split into the three categories of journal and different types of repositories, since they have usually covered all. This author can testify that all of these helped in raising awareness in Finland, in the formation of a core of OA advocates, mainly amongst scientists and university librarians. This core of persons formed a national OA committee, FinnOA in 2003, which has influenced the policy setting of the ministry of education, main research funders and individual universities.

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